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FRIDAY, MAY 24, 1895.

CONTENTS:

Variation of Latitude: J. K. REES.....561
Current Notes on Physiography (VII.): W. M. DAVIS.....568
Gravity Measurements: HERBERT G. OGDEN....571
The Astronomical and Physical Society of Toronto: THOMAS LINDSAY.....573
Correspondence:— 575
The Rivers of Eden. J. WILLIAM DAWSON. *Color-association with Numerals:* E. S. HOLDEN. *University of Kansas, State Geological Survey:* F. H. SNOW.
Scientific Literature:—.....577
Nehrling's Native Birds: C. HART MERRIAM *Shaw's Municipal Government:* J. S. B. *Nernst's Chemistry.* ROBERT H. BRADBURY. *Society for the Promotion of Engineering Education.* R. H. T. *Steam Power and Millwork:* R. H. T.
Notes and News:— 581
Joints in the Vertebrate Skeleton: H. F. O. *The Preparation of Argon:* J. E. GILPIN. *Helion; Gravity Measurements; General.*
Societies and Academies:— 586
Scientific Societies of Washington; The Biological Society of Washington; Boston Society of Natural History; Minnesota Academy of Natural Sciences.
New Books 588

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*VARIATION OF LATITUDE.**

THE question is frequently asked, "How can latitude change?" There are two ways obviously. First, we may imagine that a portion of the earth slips on the surface of the globe, due say to earthquake shock. Then if the movement of the mass has been toward the equator the latitude of that place is decreased; if toward the pole of the earth the latitude is increased. But suppose that some forces at work on the earth cause it to revolve about a new axis, then we have at once a new equator, and the latitudes of *all* points on the earth's surface change except at those places where the old and new equator intersect.

If, for example, the earth's axis of revolution should be changed so as to pass through this hall, the latitude would be changed from a little over 40 degrees, as it now is, to 90 degrees. There are changes no doubt produced by the slipping of portions of the earth's strata, but we know that these causes are insignificant and local. The only way that latitudes could be made to change *throughout the world* would be by changes in the axis of rotation of the earth, thus changing the position of the equator.

Are there any undisputed evidences of a variation in the latitude of a place and is it large?

To-day the evidence is overwhelming, but the amount is small, so small, in fact, that only the refined instruments of the present day have been able to discover it; though now, that it is discovered, older observations show it.

La Place, in his Mécanique Céleste (Tome V., p. 22), says "All astronomy depends upon the invariability of the earth's

* From a lecture before the New York Academy of Sciences, April 29, 1895.

axis of rotation and upon the uniformity of this rotation."

He considered that down to the beginning of this century astronomical instruments had not been able to show any variation of latitudes. There were differences, but these he thought could be accounted for as errors of observation.*

To-day, however, we feel certain that small variations in latitude are taking place, but so small that practically, in map making, for example, and in navigation, they are of no importance, though scientifically very important.

It might also, in this connection, be stated that there are theoretical reasons which seem to indicate that the earth's *rotation time* is not only changing, but also is not altogether uniform. The effect of the tide-wave as it moves west over the earth is to act as a friction-brake on the revolving earth, and so slow up the rotation time, and as this tide effect is not always the same the retarding effects differ, and theoretically produce a non-uniformity in the rotation time. But the shrinkage of the earth, due to loss of heat, would tend to make it revolve more rapidly. These effects may work against each other. However, observations and calculations to-day do not furnish us with any certain evidence that the rotation time is longer or shorter than it was ten centuries ago.

It no doubt will happen that, when observations and instruments are much improved, astronomers will discover these slight changes in rotation time that theory seems to require.

The idea that the latitudes of places change is not a new one.

Down to about the time that the telescope was invented there were many learned persons who believed that the latitudes of places changed several degrees in the course of centuries. These ideas were based on a comparison of maps made at different times.

A disciple of the illustrious Copernicus considered that the evidence was conclusive, and was satisfied that the pole of the earth was changing its position in a *progressive* manner; he considered that in time the torrid and frigid zones would change places.

However, these views of Dominique Maria de Ferrare were founded on poor data. The latitudes of a few places had been determined, by very imperfect means, in the best way they had, viz., from the shadow cast by a gnomon; but the latitudes of many places on the maps were put in from the accounts of travelers, the time it took to travel from one point to another being used as the basis of calculation.

Even in these enlightened days, as we like to consider them, there is no good map of our own Empire State. The latitudes of a few points only in New York State have been determined with accuracy. But there are many places in the State whose positions are not known within more than a mile.

In the latter part of the 16th century Tycho Brahe, of Denmark, improved the instruments in use (without the telescope), and later, about 1610, the telescope was discovered and applied to astronomical instruments. Then new and more accurate methods were used to determine latitude, and the large discrepancies disappeared. Some observers found differences between latitudes determined in winter and in summer, and they supposed those differences to be due to changes of the pole.

In the latter part of the 17th century J. D. Cassini summed up the state of the problem in his day, and arrived at the conclusion that, notwithstanding the apparent variations in the latitudes, the pole of the

* The writer is much indebted to the paper by Professor Doolittle on 'Variations of Latitude' read before the A. A. A. S., at Madison, Wis., August, 1893.

earth did not change to any *large extent*; that most of the apparent changes in latitude were due to errors of observation and defects in theory, but he thought it probable that *small* changes did occur in the position of the pole; he thought the changes were *periodic*, and did not amount to more than two minutes of arc equal to about 12,000 feet. "Thus, instead of several degrees which were conceded by the astronomers of of previous centuries, but a paltry two minutes was now allowed; but with improved instruments, with the discovery of aberration and nutation and the perfection of the theory of refraction, even this modest allowance was gradually reduced to a vanishing quantity."

The geologists, in their investigations, have found fossil remains in the cold regions of the north, belonging to the Miocene, Upper and lower Cretaceous, Jurassic and other geological periods, which seem to indicate a former temperature much higher than the present. In 1876 Dr. John Evans, then President of the British Geological Society, discussed the problem, and concluded that the amount of polar light and heat in the past must have been much greater than it is now. He invited the attention of the mathematicians to this problem, and asked: Would a considerable elevation and depression of the sea bottoms and continents produce a 'change of 15 degrees to 20 degrees in the position of the pole?'

Sir William Thomson discussed this problem and gave his conclusions in 1876 to the British Association for Advancement of Science. He said: "Consider the great facts of the Himalayas and Andes and Africa, and the depths of the Atlantic, and America and the depths of the Pacific, and Australia; and consider further the ellipticity of the equatorial section of the sea level, estimated by Colonel Clarke at about one-tenth of the mean ellipticity of the meridianal sections of the sea level.

"We need no brush from a comet's tail to account for a change in the earth's axis; we need no violent convulsions producing a sudden distortion on a great scale, with change of axis of maximum moment of inertia, followed by gigantic deluges; and we may not merely admit, but assert as highly probable, that the axis of maximum inertia and the axis of rotation, always near one another, may have been in ancient times very far from their present geographical position, and may have gradually shifted through ten, twenty, thirty or forty or more degrees without at any time any perceptible sudden disturbance of either land or water."

Sir William Thomson gave no account of the calculations made by him as the basis of these conclusions.

In 1877 Mr. G. H. Darwin made a careful and elaborate mathematical discussion of the problem. He showed that, in a *perfectly rigid* globe, the pole could not have wandered more than 3 degrees from its original position, as the result of the continents and oceans changing places. "If, however, the earth is sufficiently plastic to admit of readjustment to new forms of equilibrium, by earthquakes and otherwise, possible changes of ten or fifteen degrees may have occurred. This would require, however, such a complete changing about of the continents and oceans, with maximum elevations and depressions in precisely the most favorable places, as has certainly never occurred in geologic times."

The evidence indicates, in fact, that the continental areas have always occupied about the same positions as now.

Thus it would seem that the geologists must abandon the hypothesis of *great* changes in latitude as a factor in the earth's development, unless a new cause can be found that will move the pole to the extent required by the geologists.

In an address made before Section A, of the British Association in 1892, Professor

Shuster stated that he believed the evidence at hand was in favor of the view that there was sufficient matter in interplanetary space to make it a conductor of electricity. This conductivity, however, must be small, for if it were not, he said, the earth would gradually set itself to revolve about its magnetic poles. However, changes in the position of the magnetic poles would tend to prevent this result. Perhaps the investigator in the near future, working on the suggestion of Dr. Shuster, may find some connection between the earth's magnetism, rotation time and position of rotation axis.

The evidence, then, at this phase of the discussion, is in favor of the view that there is no adequate reason for believing that any *large changes* of latitude, amounting to several degrees, have occurred in geologic times. The evidence shows, however, that there are small changes. Are they *progressive;* does the north pole of the earth wander slowly but surely further and further away from its positions of ages gone by?

At the International Geodetic Congress held in 1883 at Rome, Sig. Fergola, of the Royal Observatory Cappodimonti, Naples, gave a tabular statement which seemed to show that small but *progressive* changes *had* taken place in Europe and America. This table showed, for example, that the latitude of Washington, D. C., had decreased from 1845 to 1865, 0.47″; at Paris, from 1825 to 1853, the decrease was 1.8″; at Milan in 60 years, 1.5″; at Rome during 56 years, 0.17″; at Naples in 51 years, 0.22″; at Königsberg in 23 years, 0.15″; at Greenwich in 19 years, 0.51″. Fergola, at the Congress mentioned, suggested a plan for making systematic observations, and he pointed out the favorable location of several observatories that were on nearly the same circle of latitude, but differing widely in longitude. Unfortunately this suggestion of Fergola's was not carried out in any way until 1892, when the Columbia College Observatory arranged to work in conjunction with the Naples Observatory on the problem. This series of observations was begun in the spring of 1893, and will be continued several years.

The data given by Fergola at Rome in 1883 showed a diminution of latitude in every case; other data showed a similar diminution; however there were exceptions, where the latitudes seemed to increase.

The investigations that have been going on since 1883 throw doubt on the *progressive* changes in latitude, or at least such changes are masked by proved *periodic changes*.

For a long time, since 1765, periodic changes have been looked for, because the theory of a rotating earth, an earth having the form of a sphere flattened at the poles, or, more accurately, an ellipsoid of revolution, demanded such changes; but the theory did not furnish any clue to the amount of changes, except that they must be very small. This theory shows that if the earth was *absolutely rigid* and revolved about its shortest axis (called the axis of figure) at any time it would continue to revolve about such axis forever, unless disturbed by some outside force. If so disturbed, then the axis of rotation would no longer coincide with the axis of figure—the axis of rotation would intersect the earth's surface at points away from the points where the axis of figure comes out. But the theory also showed that the new axis of rotation would revolve about the old one in a period of 304.8 days. This period comes from the knowledge of the magnitude of precession and nutation, and is known very accurately.

We would expect therefore that changes in latitude would show this 305-day period.

Several attempts have been made to determine the distance between the two axes (figure and rotation axis) from changes in latitudes.

The celebrated astronomer Bessel made

the first attempt, and was unsuccessful, it was supposed until recently.*

Observations were also made at Pulkova, Russia, Greenwich and Washington. The Washington observations were made between 1862 and '67, and included six complete periods of 305 days each. A rigorous discussion by Newcomb gave the separation of the axes as 3 feet, or 0.03″.

C. A. F. Peters, of Pulkova, had in 1842, obtained ″.079 = 8 feet.

These figures are small, but fairly accordant. A reinvestigation, however, showed that the various calculations did not agree in showing the same displacement at the same time. This made the whole result doubtful, so that Newcomb (in 1892, March, Mon. Not. R. A. S.) remarked that "the observations showed beyond doubt there could be no inequality of the kind looked for."

It was while investigations of this kind, to determine the separation of the axis of rotation and axis of figure, were going on that Sir Wm. Thomson (now Lord Kelvin) announced, at the Congress of the British Association at Glasgow in 1874, that the meteorological phenomena, the fall of rain and snow, the changes which occur in the circulation of the air and of the sea waters would modify a little the mechanical constitution of the globe, and displace a little the *axis of figure*, *i. e.*, the form of the earth would be changed by the causes mentioned, and so a new shortest axis would be made. The effect of this would be to produce a change in the latitudes of places, evidently. He thought that it might amount to ″.50, which would correspond to a movement of the old axis (at the pole) of 50 feet on the earth's surface. Sir W. Thomson did not publish his calculation, but the authority of the great English mathematician and physicist was such as to make scientific men give the statement great attention. These meteorologic phenomena of which Sir William Thomson spoke are annual in character. When this annual period is combined with the 305-day or ten-month period of Euler we see that complexity results. This was the state of the investigation when Dr. Küstner, of the Berlin Observatory, published the results of his observations made in 1884–1885. Dr. Küstner undertook some observations for the trial of a new method for the determination of the constant of aberration. On reducing his observations he obtained results which were not at all satisfactory. A careful examination of his work led him to make the announcement that the unsatisfactory value for the aberration constant was due to a comparatively rapid, though very small, change in the latitude of the Berlin Observatory—"that from August to November, 1884, the latitude of Berlin had been from ″.2 to ″.3 *greater* than from March to May in 1884 and 1885."

* Tisserand says in Ann. Bur. Long. '95 (P. 42, B. 11) that there is a letter of April 7, 1846, in which Humboldt replies to Gauss that Bessel had told him in 1844 that his observations showed that his latitude had decreased 0. 3″ in two years. Bessel attributed this variation to changes accomplished in the interior of the globe. See also Hagan's letter in Astr. Nach., September, 1894.

In this connection it ought to be noted also that Prof. J. C. Maxwell read a paper April 20, 1857, before the Royal Society of Edinburgh (see Transactions Roy. Soc. Edinburgh, Vol. XXI., Part iv., pp. 559–571), 'On a Dynamical Top for exhibiting the phenomena of the motion of a system of invariable form about a fixed point, with some suggestions as to the earth's motion.' He deduced a period of 325.6 solar days. He examined the observations of *Polaris* made with the Greenwich Transit Circle in the years 1851–54. He found the apparent co-latitude of Greenwich for each month of the four years specified.

"There appeared a very slight indication of a maximum belonging to the set of months, March, '51; February, '52; December, '52; November, '53; September, '54." This result, he says, "is to be regarded as very doubtful, as there did not appear to be evidence for any variation exceeding half a second of space and more observations would be required to establish the existence of so small a variation at all."

This would indicate that from August to November, 1884, the pole of the earth had approached Berlin more closely by 20 to 30 feet than in the time from March to May.

This conclusion was fortified by the examination of other data, obtained from the observations made at Pulkova by Nyrén.

Here, then, was evidence of a comparatively rapid change in latitude. New observations were undertaken at Berlin, Potsdam, Prague, and Bethlehem, Penn. (all by Talcott's method), and all agreed in showing plus and minus changes in latitude for the years 1888–'90.

There were still some doubters. Moreover it was decided to critically test the matter by sending an expedition to the Sandwich Islands, which is 180 degrees (nearly) in longitude from Berlin. If it was known the latitude of Berlin increased, then a point in the northern hemisphere 180 degrees away from Berlin should simultaneously show a decrease in latitude, for if the pole moves toward Berlin it must move from the point on the other side of the earth.

Our own Government joined in the effort. Marcuse of Berlin and Preston of Washington spent more than a year on the Sandwich Islands observing for latitude, while at the same time observations were continued at Berlin, Prague and Strassburg in Europe, and at Rockville, Bethlehem and San Francisco in the United States. The results of all these observations have been published, and show, without a chance of error, that the earth's axis is moving, that the latitudes at the Sandwhich Islands increased when the latitudes in Germany diminished and *vice versa*.

The law of the change was eagerly and industriously sought for by some of the ablest mathematical astronomers of the world. They first worked on the idea that the changes must conform to the 305-day period of Euler, combined with an annual change due to causes set forth by Sir W. Thomson, and which I have previously mentioned. None of these investigations have given a satisfactory formula for the prediction of the latitude of any place.

In 1891 Dr. S. C. Chandler, of Cambridge, Mass., began his investigation of the problem. He remarks:

"I deliberately put aside all teaching of theory, because it seemed to me high time that the facts should be examined by a purely inductive process; that the nugatory results of all attempts to detect the existence of the Eulerian period (of 305 days) probably arose from a defect of the theory itself, and that the entangled condition of the whole subject required that it should be examined afresh by processes unfettered by any preconceived notions whatever. The problem which I therefore proposed to myself was to see whether it would not be possible to lay the numerous ghosts in the shape of various discordant, residual phenomena pertaining to determinations of aberration, parallaxes, latitudes and the like, which have heretofore flitted elusively about the astronomy of precision during the century, or to reduce them to some tangible form by some simple consistent hypothesis. It was thought that if this could be done a study of the nature of the forces as thus indicated, by which the earth's rotation is influenced, might tend to a physical explanation of them."

Dr. Chandler proceeded to examine his own work with the Almucantar at Cambridge, the observations of Küstner, Gyldén, Nyrén, the Washington observations and others. He found that they all seemed to indicate that the pole of the rotation axis was moving from west to east about the axis of figure of the earth in a period of 427 days. Other observations did not seem to confirm this period. Finally he made an elaborate analysis of 33,000 observations between 1837 and 1891, and the result was an empirical law which can be announced as follows:

The pole of the rotation axis of the earth moved with its greatest velocity about the pole of the axis of figure about the year 1774; the period then was 348 days. The velocity has diminished with an accelerated rate since then. In 1890 the period was 443 days. The distance of one pole from the other was about 22 feet = 0.22″.

Further elaborate examination of this material developed the exceedingly important and interesting result that the changes in latitude were the sum of *two periodic* fluctuations superposed on each other. One had a period of about 427 days and an amplitude of 0.12″ The second had a period of a year with an amplitude that was variable between .04″ and .20″

Sometimes these two fluctuations worked together, giving a total range of .33″, and at times they conspired against each other, reducing the range to a minimum of a few hundredths of a second. He compared his theory with the observations, and the result was in the main exceedingly satisfactory.

His conclusions were attacked as to the 427-day term. The annual term could be explained as due to meteorologic causes.

Professor Newcomb, however, in March, 1892, explained in a paper communicated to the Monthly Notices of the Royal Astronomical Society that in deducing the Eulerian period of 305 days the earth, as we have remarked, was considered *absolutely rigid;* that when the effect of the mobility of the oceans and of the lack of perfect rigidity of the earth were taken into account, the mathematics required a time of rotation of the true pole about the axis of figure longer than the previously accepted 305 days. Making certain assumptions Newcomb obtained a period of 443 days.*

An additional interesting conclusion which Dr. Chandler has lately published is that the fluctuation with a period of 427–428 days is a circular one, as theory seems to demand, while the annual fluctuations appear elliptical in character.

An exceedingly interesting and important confirmation of the Chandlerian period of 427 days, or about 14 months, was lately announced by M. Tisserand. Examination has been made of the tide records of the Helder in Holland. These are kept with great accuracy. It has been found that between 1851 and 1893 these tide records show a variation in the average sea level indicating a 14-month period. The greatest divergencies are very small, only 14 mm.= ½ inch about, but they appear unmistakably and are what theory would demand.

In a letter recently received from Dr. Chandler he states that he finds that the annual part of the polar motion is an ellipse three or four times as long as broad, and he expresses the law of the motion of the pole in this ellipse as that the areas described from the centre are proportional to the times.

We can conclude safely, therefore, that no large changes of latitude have taken place for many thousands of years; in fact, in geologic times, that there is no adequate proof of *progressive* changes in the latitude of any place; but finally that very small periodic changes have occurred, and they are such as can be and are observed.

The feeling is growing in the minds of those who have given the subject close attention that we shall find that many and various causes enter into the problem of determining the law of changes. It will, no doubt, take many years of careful observation to obtain the data necessary to fully test Dr. Chandler's or any other hypothesis.

The scientific men abroad are discussing the advisability of establishing several observatories at various places on the earth's surface, for the purpose of collecting the data.

*Professor R. S. Woodward has lately obtained by a new discussion of the theoretical problem a formula that seems to indicate the correctness of Chandler's empirical formula.

Ultimately Dr. Chandler's formula, or a slight modification of it, may be proved correct, and with it we may be able to state what the latitude of any place will be at any time.

The lecture was followed by some illustrations showing that revolving bodies preferred to revolve about their shortest axis or around the axis about which the moment of inertia was a maximum.

Charts and diagrams were exhibited showing the results of observations made at Pulkova, Prague, Berlin, Strassburg, Bethlehem and the Sandwich Islands, etc.

These results were compared with the deductions from Chandler's formula and shown to agree therewith to a remarkable extent.

The preliminary results of the observations made at Columbia College from May, '93, to July, '94, were exhibited.

The lecturer threw on the screen illustrations of several forms of Zenith Telescopes and described the new form made by Wanschaff, of Berlin.

J. K. Rees.

Columbia College.

CURRENT NOTES ON PHYSIOGRAPHY (VII.).

AREA OF LAND AND WATER.

Professor H. Wagner, of Göttingen, contributes to the April number of the Scottish Geographical Magazine an abstract of his recent studies on the land and water areas of the globe for successive latitude belts. He contends that Murray's figures, published in the same magazine for 1886 and 1888 and based on Bartholemew's maps, are inaccurate to a significant extent. Wagner's measures of the better known lands between 80° north and 60° south latitude is 51,147,100, against Murray's 51,298,400 square miles. Taking 250,000 for lands yet undiscovered in the Arctic regions, and 3,500,000 for Antarctic lands, the total land area of the globe would be 55,814,000 square miles. Wagner finds confirmation of his figures in the results independently obtained by K. Karstens, who has recently made a new reckoning of the area and mean depth of the oceans.

THE 'FLY-BELT' IN AFRICA.

The remarkable control over the occupation of Africa, exercised by the little tse-tse fly, whose bite is fatal to horses and cattle, leads to the introduction of cheaply constructed narrow-gauge railways across the belt of country dominated by this pest. The Portuguese district, next south of the Zambesi river on the east coast, with its capital at the little settlement of Beira, attains some commercial importance from its relation to Mashonaland and the gold district of the interior; but in order to connect the two, a railway a hundred and twenty miles long has been made 'to bridge the fly-belt.' The coast exhibits a combination of equatorial and tropical rainfall, having high temperature and heavy rain from October to April, but from June to September 'the weather is almost pleasant.' At Beira the scarcity of water in the dry season threatened a few years ago to be a serious question, as a supply had to be brought from the upper course of the rivers at a considerable cost; but "in 1893 a Scotch plumber was imported, and all anxiety on this score came to an end," as he made galvanized iron tanks in which rain water could be gathered and stored from the roofs (Scot. Geogr. Mag., April, '95).

COLD AND SNOWFALL IN ARABIA.

The ordinary association of heat with the dryness of deserts tends to give the impression that Arabia has no cold weather. Nolde's account of his expedition into the Nefud desert of the Arabian interior, latitude 28 north, altitude 3,000 feet, tells of the severe cold that he experienced there in

February, 1893. The days were warm and pleasant; but the nights cooled to –5° or –10° C; the changes of temperature being extremely sudden. For example, on February 1, at noon, the thermometer read +5°.5, with a cool wind; at 2 o'clock, +6°, at 4, 7.5°; then came a rapid rise to 25.5°, for which no special explanation is given. Just after sunset there was a sudden fall of thirty-three degrees, to –8°; and the minimum of the night was –11°. The cold and blustering wind caused much discomfort in traveling. The greatest surprise that Nolde met was on February 2, when a storm clothed the Nefud far and wide with a sheet of snow several inches deep, making it resemble a Russian steppe rather than an Arabian desert. The Bedouins, however, said that snowfall there was very unusual. (Globus, 1895, No. 11.)

CENTRAL AMERICAN RAINFALL.

PROF. M. W. HARRINGTON shows in an article under the above title (Bull. Phil. Soc. Washington, xiii., 1895, 1–30) that the northeast slope of Guatemala and Honduras has rainfall maxima in June and October, following the zenithal passages of the sun and a moderate winter maximum in January, ascribed to the encroachment even in these low latitudes of cyclonic areas from the westerly winds of the temperate zone. This gives an interesting repetition of the case of northern India, as described by Blanford. The rainfall on the southwest slope of Central America has maxima in June and September-October, corresponding to the two zenithal passages of the sun. The July-August minimum is faintly marked, while that of January and February is very low and for a time almost rainless. It is noteworthy that the zenithal rains here are often accompanied by strong squally winds from the southwest, suspected of being occasional extensions of the southeast trade wind across the equator into our hemisphere. It may be remarked that the association of these winds with the counter current that runs eastward in the Pacific a little north of the equator confirms the suggestion that the equatorial counter currents in general are caused by the extension of the trade winds of one hemisphere across the equator into the other hemisphere. They are thus deflected from a westward to an eastward course, and hence locally produce eastward currents.

THE METEOROLOGISCHE ZEITSCHRIFT.

THE thoroughness so characteristic of German scientific work appears in this excellent journal, the leader of its class, with its able original articles, its rich variety of notes and its exhaustive bibliographic reviews. Originally established thirty years ago by the Austrian Meteorological Society, and edited successively by Jelinek and Hann, of Vienna, it was enlarged eleven years ago by further assistance from the German Meteorological Society, when Köppen, of the naval observatory at Hamburg, became associate editor; his place being lately taken by Hellman of the Prussian Meteorological Institute at Berlin. Dr. Hann, however, still retains his position as leading editor and is a frequent contributor to the pages of the journal. One of his latest essays (January, 1895) is on the rainfall of the Hawaiian Islands, in which he brings together all available material, and discusses it more completely than has hitherto been done. Dutton's explanation of the considerable rainfall on the southwest slope of Hawaii is quoted with acceptance. A meteorological peculiarity of these islands seems to be that their richer windward sides, sloping to the northeast with a plentiful rainfall, are on a large part of the coast with difficulty approached from the sea on account of the cliffs that have been cut along the shore by the strong surf from waves driven by the trade winds.

FOEHN-LIKE EAST WINDS IN AFRICA.

Danckelman, who for some years has made a special study of African meteorology, contributes a note on the foehn-like east winds felt on the southwest coast of Africa, about the southern tropic (Met. Zeitschr., January, 1895). In the interior, temperatures above 27°C are unknown in the winter (April to October); but on the coast in this season, maxima over 30°, and even as high as 39°, are reported, east winds and low humidity occurring at the same time. As so high a temperature cannot be ascribed to heat from the interior, Danckelman explains it as the result of the dynamic warming of the wind during its descent from the interior highlands. This is only one more illustration of the importance of adiabatic changes of temperature in meteorological phenomena; the Swiss foehn and our western chinook, the extraordinary foehn-like winds of west Greenland, the 'hot winds' of India and of Kansas, as well as the ordinary warm or hot southerly cyclonic winds, or 'siroccos,' all owing a greater or less share of their high temperatures to the heat developed by compression during the descent of air from higher to lower levels.

THE AMERICAN METEOROLOGICAL JOURNAL.

The American Meteorological Journal, conducted for a number of years by Professor Harrington at Ann Arbor, and since 1892 edited by R. DeC. Ward and published by Ginn & Co., Boston, is an able exponent of the science of the atmosphere for this country. The closing number (April, 1895) of the eleventh volume opens with a note by the editor, reviewing the recent work of the journal, and making an excellent showing for its continuation. Its original articles make it of value to the investigator; its notes and reviews place much important material before the general student; and its more elementary or educational articles must prove useful to the teacher, for in spite of a recent assertion to the effect that the meteorological aspects of geography are well taught in our schools, there is room for much improvement in this direction. The April number contains notes on signs of a recent change of popular opinion concerning the effect of cultivation on rainfall in Iowa, the proceedings of the last meeting of the New England Meteorological Society—the only society of the kind, we believe, in this country—and diagrams of a curiously curved storm track from the Pilot chart of the Hydrographic office; reviews of the Blue Hill (Mass.) observations for 1893, of Ley's new work on clouds, and of a new Danish series of monthly pressure charts for the North Atlantic. The editor contributes an account of Swiss studies of thunderstorms, and a description of meteorological work in India and Australia. The wind known as the 'southerly burster,' as felt at Sydney, has recently been studied in a prize essay; it recalls in many particulars the 'northers' of our Texan coast.

NOTE ON CROLL'S GLACIAL THEORY.

A brief article by the undersigned (reprinted in Amer. Met. Journal for April from the Trans. Edinb. Geol. Soc., vii., 1894, 77–80) suggests a common explanation for three forms of geologically recent climatic change, namely, the glaciation of many northern lands, the expansion of many interior lakes, and the production of *wadies* by water action in the now dry Sahara. Accepting Croll's theory of the coincidence of glacial conditions with long aphelion winters during periods of great orbital eccentricity, it is argued that the chief cause of snowy precipitation at such times must be the greater activity of cyclonic processes, then intensified by the stronger general circumpolar circulation, in turn accelerated by the increased winter contrast of polar and equatorial temperatures;

Hann's dynamical theory, instead of Ferrel's convectional theory of extra-tropical cyclones, being adopted. All those regions whose precipitation is in large part dependent on extra-tropical cyclonic storms would under these conditions have an increased annual rainfall; and the lakes of interior basins in temperate latitudes would consequently increase in volume. The winter rains of subtropical belts, such as the northern Sahara, would extend further towards the equator, for the equatorward migration of the tropical belt of high pressure in winter is essentially a result of the increased vigor of the circumpolar circulation at such times; thus the formerly greater rainfall indicated by the desert *wadies* might be explained. The coincidence of greater precipitation during the same epochs of time over the glaciated, the lacustrine and the desert areas is, however, not yet independently proved.

W. M. DAVIS.

HARVARD UNIVERSITY.

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*GRAVITY MEASUREMENTS.**

RELATIVE measurements of the force of gravity were made in 1894 by the U. S. Coast and Geodetic Survey at twenty-six stations, mostly located along the thirty-ninth parallel from the Atlantic coast to Utah. Points were included on the Atlantic coast, Appalachian mountains, central plains, Rocky mountains (including the summit of Pike's Peak, 14,085 feet in altitude), western plateaus, and the eroded valleys of the Green and Grand rivers. The half second pendulum apparatus designed by Dr. T. C. Mendenhall was used, with methods not before employed with short pendulums. They were swung at a low air pressure (60 mm.), each swing lasting eight hours, and the successive swings covering the entire interval between the first and last time observations, usually forty-eight hours. The two chronometers used were rated by star observations made with a portable transit in the meridian. The flexure of the support was measured and correction applied. The results indicate the entire elimination of errors due to diurnal irregularities of rate, and show that there was practically no wear of the agate knife-edge. Determinations made at the base station (Washington) several times during the year show a range of only .000,004 second in the mean period of the three pendulums, indicating a high permanency of period, and throwing some light on the invariability of gravity. The average time required per station was slightly over five days.

Values of gravity for Washington derived relatively from absolute determinations made in various parts of the world show a considerable discordance, the range being from 980.047 to 980.285 dynes. The results of the past season are based on a provisional value adopted for Washington. As they were carried out with the same instruments and uniform methods, it is probable that their relative accuracy is much higher than that of many of the absolute measures.

The results are discussed principally in connection with the question of reduction to sea level, the distribution of the stations with respect to an unusual variety of continental conditions rendering the series valuable in this connection. This is an important question in the application of pendulum observations to the geodetic problem of the earth's figure, and involves the various theories as to the condition of the

* 'Results of a Transcontinental Series of Gravity Measurements,' by G. R. Putman, read February 2, 1895, Philosophhical Society of Washington, Bulletin Vol. xiii.; preliminary results were presented before the National Academy of Sciences by Dr. Mendenhall, November, 1894. Mr. G. K. Gilbert, of the U. S. Geological Survey coöperated in this work by making a geological examination of the stations. His conclusions and a discussion of the results in connection with the theory of isostasy are published in the same Bulletin.

earth's crust. It has given rise to many diverse opinions, and the apparent anomalies in the force of gravity have been so great with various methods of reduction as to necessitate the rejection of certain classes of stations even in the most elaborate discussions, as those of Clarke and Helmert. Three methods of reduction were applied to these stations, and the effect of latitude was eliminated by comparison with a theoretical formula based on Clarke's figure of the the earth. In each of these methods correction was made for the elevation above sea level and for topographical irregularities near the station, and they differ only in the allowance made for surface attraction, as follows:

1. Bougner's reduction. The vertical attraction of the entire mass above sea level was subtracted. With this method the results show a large defect of gravity on the western mountains and plateaus, closely proportional to the average elevation, but having no relation to the altitude of the particular point of observation or to distance from the ocean.

2. Elevation reduction. No correction was made for attraction. The defect of gravity in general disappears, but there are large residuals in the mountainous regions, gravity being in excess at stations above the average level of the surrounding country, and in defect at those below. The size of the residuals is nearly proportional to the difference in elevation between the station and the average level.

3. Faye's reduction. On the theory that the surface of the earth is in general in a condition corresponding to hydrostatic equilibriun, M. Faye proposed that no correction be made for the attraction of the average mass above sea level, but that account be taken of local deviations from the average level, as, for instance, the attraction of a mountain on a station at its summit. Developing this idea we may consider that all general continental elevations are compensated by a lack of density or other cause below sea level, but that local irregularities of surface are not so compensated, but are maintained by the partial rigidity of the earth's crust. The measure of this lack of compensation will be the attraction of a plain whose thickness is the difference in elevation between the station and the average surrounding country. The latter was estimated within an arbitrarily adopted radius of 100 miles of each point, and the correction applied, positive for stations below the average and negative for those above.* With this reduction all the large residuals disappear. For the fourteen stations (in mountainous regions) where it was applied, the sums of the residuals are: with Bougner's reduction 2.577 dynes, with elevation reduction 0.677 dynes, with Faye's reduction 0.175 dynes, indicating a decided advantage for the latter.

A similar discussion made of former Coast and Geodetic Survey observations on oceanic islands and coasts shows that the excess of gravity that has been found on islands with Bougner's reduction largely disappears on the application of Faye's idea, subtracting the attraction of islands considered as displacing sea water. The residuals with Bougner's reduction are probably a measure of the lack of density below sea level, and with the elevation reduction a measure of the lack of compensation. The general conclusion is that the so-called anomalies of gravity may be largely accounted for on general principles, and that the value of these measurements in connection with the problems of geodesy and the intimately related questions of terrestrial physics will be proportionately enhanced.

By comparing the values of g measured on the summit and near the base of Pike's Peak the value 5.63 was deduced for the

*Mr. Gibert independently applied this method of reduction, using a radius of 30 miles.

mean density of the earth. The attraction of the mountain was computed from contour maps and from information as to its density furnished by Mr. Whitman Cross of the U. S. Geological Survey. A set of quarter-second pendulums designed by Dr. Mendenhall was tested at four of the stations with satisfactory results. This is the smallest apparatus yet made for the purpose, weighing but 106 pounds with packing boxes.

HERBERT G. OGDEN.

WASHINGTON, D. C.

THE ASTRONOMICAL AND PHYSICAL SOCIETY OF TORONTO.

THIS Society, now very widely known, was originally formed in 1884 by a few gentlemen who, while actively engaged in business pursuits, were kindred spirits in their love for scientific study and met at intervals more or less regular at their respective residences for recreative reading, observation and experimentation. The membership gradually increasing, it was finally decided to secure incorporation under a general Act permitting the acquiring and holding of real and personal property, etc., and in 1890 the Society became a corporate body. The first president of the new association was the late Mr. Chas. Carpmael, M. A., F. R. A. S., the Director of the Toronto Magnetic Observatory; the vice-president was Mr. Andrew Elvins, who had indeed been the first to gather together the few friends who had formed the original nucleus, and who is still highly esteemed and honored as the father of amateur astronomy in Toronto. A constitution modeled upon that of the Astronomical Society of the Pacific having been framed and by-laws adopted, a circular was addressed to many scientific societies and distinguished astronomers and physicists throughout the world. Several of the latter became corresponding members, while various scientific bodies contributed many volumes of reports, etc., which formed the beginning of what is now a very valuable library. Without this very material aid the progress of the Toronto Society would have been very slow indeed, but as, at meeting after meeting, the secretary's and librarian's reports were read, it became soon apparent that the heartiest sympathy and support were being extended, without exception, by all who had been addressed.

The first annual report of the Society was an unpretentious little volume of 40 pages, containing abstracts of papers read during the year 1890, and records of the more important work done at the telescope by the various members who were particularly interested in observation. The frontispiece was a drawing of sun-spots and also of hydrogen flames, by Mr. A. F. Miller, who has always taken a keen interest in solar physics. Mr. T. S. H. Shearmen contributed a paper on 'Coronal Photography, in the Absence of Eclipse.' In common with many other enthusiastic observers, Mr. Shearmen is still engaged upon this work. Referring to the objection raised regarding the impossibility of photographing the corona in full sunshine on account of the very slight difference between the intensities of the two lights, Mr. Shearmen cites observations of the inferior planets seen projected on the corona.

The appendix to this volume contains a list of the presents donated by the various observatories and scientific bodies in the United States, and by Mr. John Goldie, of Galt, Ont., a life member of the Society. The list of the Society's exchanges increased very rapidly after the publication of the first report. The volume for 1891 contained papers by Dr. J. Morrison, Mr. J. Ellard Gore and Mr. W. F. Denning. An opera-glass section had been formed which met during the weeks alternating with the regular fortnightly meetings of the Society, and much interest

began to be taken in active telescopic work. An essay by Mr. G. E. Lumsden, entitled a 'Plea for the Common Telescope' (subsequently reprinted in the *Scientific American Supplement*), was the means of creating a very general desire for the possession of instruments of moderate aperture, and there are now a great many telescopes ranging to 5-inch among the members of the Society. Mr. Lumsden's own telescope is a $10\frac{1}{4}$-inch, With-Browning reflector. It was with this that he made an observation of a double shadow of Sat. I in transit across the disc of Jupiter, on the night of September 20, 1891. The particulars of the observation and comments upon theories accounting for the possible cause of the phenomenon, which has been seen but three or four times, appeared subsequently in *L'Astronomie*. A drawing of Jupiter made on the night of the observation forms the frontispiece to the volume of Transactions of the Society for 1891.

During this year the Society lost a sincere friend and earnest worker by the death of the Hon. Sir Adam Wilson, Chief-Justice of Ontario. This distinguished jurist, one of the most eminent of Canada's public men, had actively interested himself in scientific matters after retiring from the Chief-Justiceship, and had erected and equipped an observatory at his residence. Shortly after Sir Adam's decease, which was quite sudden, Lady Wilson donated to the Society his telescope, a six-inch reflector, together with other apparatus and many works on science. Sir Adam had intimated that he wished these to pass to the Society at his death. The reflector is now mounted at the residence of Mr. John A. Paterson, M. A., vice-president, and is used by the members in regular observation.

In 1892 McElvins resigned the office of vice-president, in order to have more time at his disposal during which to take up active work on special lines, notably meteorology. The constitution was amended to admit of election of two vice-presidents, and Dr. Larratt W. Smith, Q. C., and Mr. John A. Paterson, M. A., were appointed. During this year also the Hon. G. W. Ross, LL. D., Minister of Education, became Honorary President. The Society was now becoming very extensively known, and its list of correspondents rapidly increasing. The meetings were particularly well attended, and the Toronto press was most courteous and obliging in publishing reports of the Society's work from time to time. Meetings were frequently held at the Toronto observatory, where practical use was made of the large equatorial and other instruments of the equipment. The great magnetic storm of February 13, 1892, was charted by Mr. F. L. Blake, of the observing staff, and a photographic reproduction accompanied the volume for that year. Towards the close of 1892 a committee was appointed to act conjointly with a committee from the Canadian Institute with a view to moving in the matter of a change in astronomical time reckoning. The report of the committee was presented on April 21, 1893, and adopted. It is now widely known that the great majority of astronomers are in favor of reckoning the astronomical as the civil day, from midnight to midnight, and it remains for the Government of the United States to decide whether the ephemeris shall be changed accordingly. The Admiralty in England has expressed a desire to meet the views of other nations.

During 1893 the Society was enabled to further the object always kept in view, the popularizing of science, by the kindness of the University authorities, who gave the use of the physical lecture room for popular lectures, illustrated by experiment. Mr. C. A. Chant, B. A., and Mr. G. F. Hull, B. A., have taken charge of this department of the Society's work with eminent success. A very liberal interpretation of the physics

relating to astronomy having been made, there has resulted a keen interest in experimental science; so that he is a welcome addition to the membership who takes interest in any branch of what was formerly styled natural philosophy.

During the years 1893 and 1894 the subject of magnetism and electricity engaged a large portion of the time spent at the regular meetings. Spectroscopy, quite apart from its bearing upon astronomy, has also been a subject of interest. A valuable note, by Mr. A. F. Miller, on the spectrum of the light emitted by insects, appeared in the volume of Transactions for 1893.

In the earlier years of the Society's existence the meetings were held at the residences of members, but it was ultimately found that one central place of meeting would be preferable, and for some time past the regular meetings have been held in the rooms of the Young Women's Christian Guild building. Here the library is kept and the secretary has his office. The Society suffered another loss in October, 1894, by the death of the president, Mr. Carpmael, whose health had been impaired for some time previously. A short sketch of Mr. Carpmael's very active life is appended to the Transactions for 1894.

Dr. Larratt W. Smith, Q. C., succeeded Mr. Carpmael in the presidential chair, and the office vacated by the former is now ably filled by Dr. E. A. Meredith, formerly Deputy Minister of the Interior, and the predecessor of Sir Wm. Dawson in the presidential chair of McGill University, Montreal. The great work always before the Astronomical and Physical Society of Toronto is the founding of a popular observatory, in the true sense of the term; not being too sanguine, it is still hoped that steps will soon be taken to this end. It is a matter of regret that there is no astronomical equipment in Canada able to meet all the requirements of modern astronomy.

Two of the members of the Society, Messrs. Z. M. and J. R. Collins, have been very successful in making silver-on-glass specula, and have figured several of eight-inch; having recently fitted up apparatus for the work, it is confidently expected that they will soon be able to undertake the construction of very large reflectors. It is not too much to hope that they will be able to execute the telescope when the public spirit of the Toronto people demands a great observatory, and this may be in the near future, for, in regard to popularizing science, the Toronto Society has been eminently successful. A branch of the association at Meaford, Ont., has recently been formed, and other similar societies are already spoken of. THOMAS LINDSAY.

CORRESPONDENCE.

THE RIVERS OF EDEN.

TO THE EDITOR OF SCIENCE: Referring to a note on the 'Garden of Eden' in SCIENCE (May 3, 1895), I desire to point out that in a series of articles, under the heading 'Gold, Bedolach and Shoham Stone,' in the 'Expositor' (London, 1887), I showed that the only possible scientific explanation of the geography of Eden in Genesis is that based on the geological explorations of Loftus, and now advocated by Prof. Haupt, namely, that the four rivers are the Kherkhat, Karun, Tigris and Euphrates. Farther I showed that the geography and geology of this ancient author are more accurate than those of modern maps and popular statements until within a very recent time, and that the local standpoint of the original writer was on the Euphrates, and his date not long after that of the historical deluge, whatever views may be held by critics as to the ultimate editing of the book. Delitsch and others have been misled by their want of knowledge of the condition of the district in the earliest human (Palanthropic) age, whereas this was evidently known

to the original writer, though the geographical conditions must have been somewhat changed in his time.

I rejoice that a scholar like Dr. Haupt has advocated a view which will almost for the first time bring this very ancient and very accurate geographical description before the notice of modern biblical scholars in a manner which will be intelligible from their point of view.

I may add that a popular view of the geological argument on the subject will be found in my work, 'Modern Science in Bible Lands,' published in 1888,* where will also be found a sketch-map of the region, illustrating the bearing of the geological and geographical researches of Loftus and others on this much vexed and much misunderstood question.

J. William Dawson.

Montreal, May 7, 1895.

COLOR-ASSOCIATIONS WITH NUMERALS, ETC. (THIRD NOTE).

To the Editor of Science: In Science, old series, Vol. vi., No. 137, p. 242, I printed the results of some experiments upon the association of colors with letters of the alphabet, with numerals, etc., in the case of one of my daughters. In *Nature* for July 9, 1891, I gave a table exhibiting the results of these experiments in the years 1882, 1883, August, 1885, December, 1887, June, 1889, and June, 1891, a period of about nine years. The table can be readily consulted by anyone interested, so that it need not be reprinted here. In February, 1895, I again questioned my daughter on the subject, and I find that the colors given in her replies of June, 1891, are unchanged except in two cases. The figure 8 was visualized by her as white (August, 1885), cream color (December, 1887), white (June, 1889), cream (June, 1891), and is again seen as white (February, 1895). The figure 10 was noted as brown (1885), brown (1887), black ? (1889), black or brown (1891), and black (1895). With these exceptions there are no material changes. My remarks on the table, given in *Nature*, do not seem to call for any additions or subtractions. The present note, taken with the others cited, seems to be of value, as it records the results of experiments made under exceptionally good conditions and now extending over a period of some thirteen years.

Edward S. Holden.

Mount Hamilton, May, 1895.

*Harpers, New York.

UNIVERSITY OF KANSAS STATE GEOLOGICAL SURVEY.

In conformity with the law under which the University of Kansas is now working, the Board of Regents at a recent meeting formally organized the University Geological Survey of Kansas with Chancellor F. H. Snow, ex-officio Director; Professor S. W. Williston, Paleontologist; Professor Erasmus Haworth, Geologist and Mineralogist, and Professor E. H. S. Bailey, Chemist.

In addition to these, other members of the University Faculty will be engaged upon the work of the Survey, as well as the advanced students of the departments of Geology and Paleontology. An effort will also be made to centralize and unify the energies of different geologists in the State who have been doing valuable work along different lines of geological investigations. Already a considerable start has been made and the coöperation of different geologists of the State has been secured.

The policy of the Survey will be conservative, with the expectation that it will be continued and eventually include all other branches of the natural history of the State. The general stratigraphy of the State will first be elaborated in order that it may be used in the further study of various questions of economic and scientific importance, all of which will be taken up as rapidly as

existing conditions from time to time will permit.

Work in the Coal Measures of the State has been in progress for two summers, and Volume I. of the Report is now almost ready for publication. Other volumes will appear at irregular intervals. Those already under preparation are: One on Coal, Oil and Gas; one on the Vertebrate Paleontology of the State; and one on the Salt and Gypsum deposits of Kansas.

F. H. SNOW,
Chancellor University of Kansas.
LAWRENCE, KANSAS,
April 20, 1895.

SCIENTIFIC LITERATURE.

Our Native Birds of Song and Beauty. BY H. NEHRLING. 4°, 36 colored plates from originals by RIDGWAY, GOERING and MÜTZEL. Published by Geo. Brumder, Milwaukee. To be completed in 16 parts, $1.00 each.

Part eleven of this excellent work, carrying it nearly half through the second volume, has been delivered to subscribers. It is enough praise to say that the high standard of the first volume is maintained. Mr. Nehrling is a field naturalist of the kind who deem a bird in the bush worth two in the hand. He loves everything in the woods and fields, and in telling about the birds and their lives he tells also of the trees and flowers.

The aim of the book is to give trustworthy accounts, in popular style, of the haunts and habits of our birds. Occasionally it does more and introduces a new fact of scientific interest, as when the breeding of the Pine Grosbeak (*Pinicola*) is recorded for northern Wisconsin. On the other hand, it is not always down to date. For instance, under the Black Rosy Finch (*Leucosticte atrata*), the statement is quoted from Ridgway that "nothing has yet been learned as to its range during the breeding season." As a matter of fact, the species is common in summer in the higher parts of the Salmon River Mountains in Idaho, where it was obtained by the reviewer five years ago (see North American Fauna, No. 5, 1891, 102). Similarly, the Gray-crowned Rosy Finch (*L. tephrocotis*) is said to be 'a resident of the interior of British America, near or in the Rocky Mountains,' and further, that 'none seem to breed in our territory.' If Mr. Nehrling had consulted the 'Report on the Ornithology of the Death Valley Expedition,' by Dr. A. K. Fisher, he would have found the statement that this species "is a common summer resident in the higher portions of the White Mountains and the Sierra Nevada in eastern and southern California," where it breeds abundantly and where nearly 40 specimens were secured by the expedition (North Am. Fauna, No. 7, 1893, 82).

The plates are of two kinds, some show a single species in appropriate surroundings; others showing a number of species grouped together on a background of landscape or dense vegetation. The reproductions, while amply sufficient for purposes of identification, are evidently inferior to the originals, the number of stones used in printing being too small, and the workmanship not of the best. By far the most effective picture in the second volume is one of a group of winter birds—Evening Grosbeak, Pine Grosbeak, Redpoll, White-winged Crossbill, Nuthatch and Chickadee—on top of a spruce tree laden with snow. The combination of colors is striking and is aided by the red berries of a giant mountain ash, which, by the way, forgot to drop its leaves! Among the earlier plates of high merit, both in conception and execution, are several by Robert Ridgway that give charming glimpses of birds in characteristic attitudes and surroundings. Of these, the Golden-crowned Kinglet, Prothonotary Warbler, and Canon Wren are among the best.

By some accident in binding, the two plates of part 10 (pls. 13 and 15) are repeated from the first volume.

The nomenclature is that of the American Ornithologists' Union, except that the authority given is for the combination, not for the species—an unfortunate departure, inasmuch as it does not tell who was the original describer of the species.

To those unfamiliar with the first volume it may be said that the work is not a scientific treatise at all, but a popular book devoted to the life histories of birds, and based mainly on the authors' extensive field experiences, supplemented by quotations—perhaps too lengthy and frequent—from the writings of well-known ornithologists. It does not profess to cover all North American birds, omitting the water birds, birds of prey and a few others, but treats primarily, as its title indicates, of 'Our Native Birds of Song and Beauty.' It is a large, well printed quarto, and of its kind is incomparably the best book yet published in America. C. H. M.

Municipal Government in Great Britain: By Albert Shaw. New York, The Century Co. 1895, 8°, viii + 385.

The modern increase of cities, and of the proportion of urban population as compared with that of rural districts, is, according to Mr. Shaw, to be accepted as a permanent fact for this generation and its immediate successors, and,instead of lamenting over it, it is the duty of thinking men to devise ways and means to do away with or diminish the evils which are at present connected with city life. The author states his point of view as being that a city government should so order the general affairs and interests of the community as to conduce positively to the welfare of its people, or, at all events, to make it certain that for the average family the life of the town shall not be necessarily detrimental. The object of the book is to show how some of the older and larger British cities have dealt with this problem, giving details as to their modern forms of government, method of elections and modes of securing pure water, cleanliness, rapid transit, prevention of contagious diseases, etc.

The cities selected for this purpose are Glasgow, Manchester, Birmingham and London, and for each a vast amount of information is clearly and concisely given.

Taking Birmingham as an example, it is shown that in twenty years the death rate of the city was lowered twenty per cent., and, in some parts of the city, sixty per cent.; that the provisions for the comfort and recreation of the people have been greatly increased, and that, while over forty millions of dollars have been expended in securing these improvements, the taxes have not been increased, because the municipal gas and water works, street railways, markets, etc., have been from the financial, as well as from the utilitarian, point of view completely successful. Surely it is worth while for the citizens of American cities to inquire how this has been accomplished.

The description of the means used by the city of Glasgow for the isolation and treatment of infectous disease is worthy of careful study. The Contagious Diseases Hospital has been given the semblance of a lovely village, and Mr. Shaw truly says that "the difference between popularity and unpopularity in a public hospital for infectious diseases may well mean all the difference between a terrible epidemic and its easy prevention." The sanitary wash houses of Glasgow are a feature of the work of the Health Department which finds no parallel in American cities but which is of great importance. One of these cost $50,000, another $75,000, and they far more than repay their cost.

The author promises a second volume

treating of municipal government in the chief countries of Continental Europe, and if we could be assured of a third volume, prepared with equal care and accuracy, 'On Municipal Governments in the United States, or how not to do it,' it would be, as Artemus expressed it, 'a sweet boon.' Meantime, let Mr. Shaw's first volume be made a subject of special study by the younger professional men in this country, for the time is near at hand when they will be compelled to take some definite line of action with regard to our own cities, each of which presents its own peculiar problems, but problems upon which much light is thrown by the experiences of our transatlantic brothers. J. S. B.

Theoretical Chemistry. By PROFESSOR W. NERNST, Ph. D., University of Göttingen, translated by PROFESSOR C. S. PALMER, Ph. D., University of Colorado. Macmillan & Co. Pp. 697. Price $5.00.

It has long been evident that the treatment of the physical side of chemistry, in text-books avowedly devoted to chemical theory, is not satisfactory. In the present work Physical Chemistry is the main object in hand, and, correspondingly, chemical theory proper is relegated to a subordinate position. The treatment of purely chemical topics is clear and suggestive, but brief, and occasionally inadequate. Thus the discussion of the stereochemistry of nitrogen is confined to the mere statement of the views of Hantzsch and Werner, with not even the barest mention of the difficulties and exceptions which have led many to regard the spatial conception, so far as it applies to nitrogen, as prematurely developed.

But insufficiency of this kind is to be expected whenever the attempt is made to cover the whole field of chemical and physico-chemical theory within the limits of the same work, and it would be unfair to criticise Professor Nernst's book adversely on the ground of inadequate treatment of purely chemical topics which, presumably, were introduced simply for the sake of completeness. We pass, therefore, to the main subject.

For some time a work has been needed which would give concisely the remarkable results of the new Physical Chemistry, and this want Professor Nernst's work is well fitted to meet. The material is well selected, the sections are well proportioned, the facts are accurately and concisely stated, and the translation has been faithfully made, too faithfully perhaps, by one who is evidently well fitted, on the scientific side, for the task.

It may not be out of place to express the opinion that the almost complete abandonment of the historical method which characterizes Professor Nernst's work is a mistake, even in so small a volume. This is particularly plain in the account of the doctrine of electrolytic dissociation. One who reads the fascinating chapter 'Geschichte der Electrochemie' in Ostwald's 'Lehrbuch der Allgemeinen Chemie,' Vol. I., part II., observes this concept vaguely adumbrated in the minds of Grotthus and Daniell, sees it implicitly present in the remarkable views of Clausius, and finally recognizes it freed from all obscurity in the papers of Arrhenius. In Nernst, on the contrary, one is introduced to the doctrine fully formed, and, looking about him in some bewilderment to ascertain its source, discovers an incomplete justification for its existence in the behavior of aqueous salt solutions.

The student who desires to devote himself specially to Physical Chemistry may read the book with profit, but he would do better, having acquired the necessary physical, mathematical and chemical preparation, to go directly to Ostwald's 'Lehrbuch'; to those who wish simply to obtain a broad view of the present state of the science the work will be decidedly acceptable, and this will be its chief function.

It is not pleasant to be obliged to record the complete failure of Professor Palmer's attempt to 'make the sound German speak good English.' The 'sound German' seems to be unusually refractory in his hands, and frequently refuses not only to 'speak good English,' but also to speak any kind of intelligible English at all.

An unpleasant appearance is given to the pages by the translator's unfortunate practice of introducing phrases from the original, sometimes directly, sometimes in curiously infelicitous translation. Thus, in the section in which the applications of the first law of heat to chemical reactions are discussed we read, to express thermal evolution or absorption, either 'Wärmetönung,' which is clear enough, but out of place, or 'heat toning,' a phrase which one struggles vainly to comprehend. Thus he replaces the word element by the remarkable expression 'ground-stuff.' He advocates the introduction of the term 'Knall gas,' and employs it faithfully himself. Rarely the translation attains to complete unintelligibility, *e. g.*, on page 149:

"The choice of a suitable hypothesis to be advanced can be easily made, now or never, in the case before us."

It must be admitted that Professor Palmer's English is by no means pleasant reading. Those with any feeling for the right use of language will be incessantly irritated by it, and even others will be not infrequently annoyed by the unnecessary difficulties which it introduces.

The defects of the translation are undoubtedly serious. But for this there is much compensation. It is plain that the translator has followed the wonderful development of the new science faithfully, and his own comprehension of the subject is evident on every page. The student who will forgive the obvious defects, which, after all, concern rather the appearance than the substance, and give to the book an earnest, thoughtful reading, can not fail to derive from it a large amount of valuable information.

Robert H. Bradbury.

Proceedings of the Society for the Promotion of Engineering Education, Vol II., Brooklyn Meeting, 1894. Edited by Professors Swain, Baker and Johnson. 8vo, pp. viii., 292. $2.50.

This excellent collection of interesting and helpful papers is issued to the members of the Society; but, as we understand from an inserted slip, copies may be obtained from the Secretary, Professor J. B. Johnson, of Washington University, St. Louis, at the regular price paid by members. The volume is well made up, and its contents justify a good form of make-up. The book contains the usual statement of the objects of the Society, the rules, and the lists of officers and members, followed by the complete papers of the the meeting of 1894. The Society was organized in Chicago in 1893, and its next meeting, at Brooklyn, is that here given record. Its membership, already about 160, includes probably the majority of the recognized leaders among representatives of the department of education to which its belongs. The discussions are mainly on subjects of immediate interest to the teachers in the professional engineering schools, and are necessarily of great importance to them and their pupils, though perhaps less attractive to the average reader than are discussions of educational matters generally. The requirements for admission, the character and designation of the degrees properly conferred, the teachers and the text-books, methods and extent of shop and laboratory work, and forms of curricula suitable to this special work, are the main topics, and they are well and dispassionately treated. The volume is full of useful and instructive matter.

R. H. T.

Steam Power and Millwork: By GEO. W. SUTCLIFFE. Whittaker & Co., London; Macmillan & Co., New York. 12mo, pp. xv. 886. 1895. $4.50.

This book is one of the excellent series for specialists published recently by this firm, and is a very good example of the kind of work now coming to be so common in technical departments. It is written for those who are interested in the design, manufacture and use of steam engines, mill machinery and similar apparatus, and presumably represents the condensed experience of its author. The book gives valuable information relative to the most modern systems of production and transmission of power, and the latest forms of engine boilers and transmitting mechanisms, and their details, including also instructions regarding their proportions and for their maintenance. The 157 illustrations are numerous and good, representing every essential detail of which description is given. Numerous tables are distributed through the pages of text, and afford a condensed presentation of facts and data required in the computation of designs. The discussion relates principally to the steam engine; but considerable space is given to rope and other transmissions, and the customary forms of power-transmission by the older methods. References are freely given, and the book is thus made, not only intrinsically valuable, but a key to the extensive literature of its subject and field. The book will prove an excellent contribution to the library, especially of the young engineer.

R. H. T.

NOTES AND NEWS.

JOINTS IN THE VERTEBRATE SKELETON.

IN the last number of the *Archiv für Entwickelungsmechanik der Organismen* is the completion of Gustav Tornier's elaborate investigation upon 'The Origin of the Forms of the Joints in the Vertebrate Skeleton.' The writer is apparently unaware of the work which has been done upon the same subject by Ryder, Cope and others in this country, and his conclusions are therefore of all the greater interest since, while independently reached, they are in accord with the American Neo-Lamarckians so far as the adaptive power of individual reaction is concerned. He concludes as follows: The forms of the joints arise by the adaptation of the organism to external conditions of life, and are the results of mechanical influences which are directed upon the joint apparatus by the action of the muscular system. These mechanical stimuli act directly upon the joints, and lead not through the reproductive cells, but directly through the transformation of those parts of the body which are under these changing influences. Joints, therefore, arise according to the principle announced by Wilhelm Roux of 'functional adaptation,' and of the 'self formation of the useful,' 'of adaptation of the organism to functions through the exercise of these functions.' Since comparative anatomy affords the surest tests of the truth of these principles, proofs which have not had their inspiration in Roux's declarations, but have led a long way toward them and are still showing the application of these principles in questions of theoretical evolution, how useful it would be were these principles also extended into other fields of research! At the same time these proofs indicate that comparative anatomy united with pathology present two of the routes by which this goal can and will be reached. This number also contains the experimental studies in teratogeny by Mitrophanow, and a continuation of Driesch's experimental work.

This journal has become the medium of publication of the new school in Germany which revolts against the extreme to which Weismann has carried the theory of selection, and represents partly the thought

which is independent of all theories, partly that which, as seen in the above quotation from Tornier's paper, is analogous to American Neo-Lamarckism. It differs from the American school in the cardinal point, however, that judgment is suspended as to the inheritance of acquired characters.

H. F. O.

THE PREPARATION OF ARGON.

Since the announcement, by Lord Rayleigh and Prof. Ramsay, of the isolation of a new constituent of the atmosphere, any information as to the nature of this substance has been received with interest by the scientific world. Guntz has recently described, in the *Comptes Rendus*, a modification of the method used by Rayleigh and Ramsay for its preparation. This author has substituted lithium for magnesium, thereby securing the absorption of the nitrogen more readily at a lower temperature. The preparation of pure lithium in quantity has hitherto been a difficult problem, but Guntz has devised a simple method for its preparation in large quantities.

This consists in the electrolytic decomposition of a mixture of equal parts of lithium chloride and potassium chloride, the latter being introduced to lower the temperature at which the decomposition takes place. The decomposition is carried on in porcelain crucibles and the molten lithium poured into molds. It is free from iron and silica, but contains a small amount of potassium chloride.

The experiment showing the presence of argon in atmospheric nitrogen and its absence from chemical nitrogen, the latter term being used for nitrogen obtained from chemical substances by decomposition, consists in introducing the nitrogen into a glass tube containing the lithium in a boat. The glass tube is connected with a manometer to show the change in pressure. Upon heating the metal to dull redness, combination of the nitrogen and lithium takes place with incandescence. The manometer after the operation shows a pressure of about 10 mm. Upon introducing another volume of nitrogen and repeating the operation about the same amount of argon is obtained, and this process can be continued until the tube is filled with argon. If, however, chemical nitrogen is used there is total absorption, showing that atmospheric nitrogen contains some constituents not present in chemical nitrogen.

J. E. Gilpin.

HELION.

Prof. Ramsay has kindly sent us the following abstract of his paper on 'Helion, a Gaseous Consistent of certain Minerals.' Part I., received by the Royal Society on April 27th:

An account is given of the extraction of a mixture of hydrogen and helion from a felspathic rock containing the mineral clèveite. It is shown that in all probability the gas described in the preliminary note of March 26 was contaminated with atmospheric argon.

The gas now obtained consists of hydrogen, probably derived from some free metal in the felspar, some nitrogen and helion. The density of helion, nearly free from nitrogen, was found to be 3.89. From the wave-length of sound in the gas, from which the theoretical ratio of specific heats 1.66 is approximately obtained, the conclusion may be drawn that helion, like argon, is monatomic. Evidence is produced that the gas evolved from clèveite is not a hydride, and a comparison is made of the spectra of argon and helion. There are four specially characteristic lines in the helion spectrum which are absent from that of argon; they are a brilliant red, the D_3 line of a very brilliant yellow, a peacock-green line, and a brilliant violet line. One curious fact is that the gas from clèveite, freed from all

impurities removable by sparking with oxygen in presence of caustic potash, exhibits one, and only one, of the characteristic bright red pair of argon lines. This, and other evidence of the same kind, appears to suggest that atmospheric argon and helion have some common constituent.

Attention is drawn to the fact that on subtracting 16 (the common difference between the atomic weights of elements of the first and second series) from 20, the approximate density of argon, the remainder is 4, a number closely approximating to the density of helion; or, if 32 be subtracted from 40, the atomic weight of argon if it be a monatomic gas, the remainder is 8, or twice the density of helion, and its atomic weight if it too is a monatomic gas.

GRAVITY MEASUREMENTS.

AT a meeting of the Philosophical Society of Washington on March 16th Mr. G. K. Gilbert discussed the gravity determinations reported by Mr. G. R. Putnam, an account of which is given elsewhere in the present number of SCIENCE. Mr. Gilbert summarizes his conclusions as follows:

"The measurements of gravity appear far more harmonious when the method of reduction postulates isostacy than when it postulates high rigidity. Nearly all the local peculiarities of gravity admit of simple and rational explanation on the theory that the continent as a whole is approximately isostatic, and that the interior plain is almost perfectly isostatic. Most of the deviations from the normal arise from excess of matter and are associated with uplift. The Appalachian and Rocky mountains and the Wasatch plateau all appear to be of the nature of added loads, the whole mass above the neighboring plains being rigidly upheld. The Colorado plateau province seems to have an excess of matter, and the Desert Range province may also be overloaded. The fact that the six stations from Pike's Peak to Salt Lake City, covering a distance of 375 miles, show an average excess of 1,345 rock-feet indicates greater sustaining power than is ordinarily ascribed to the lithosphere by the advocates of isostacy. It indicates also that the district used in this discussion for estimating the height of the mean plain is far too small; even the radius of 100 miles selected by Mr. Putnam may not be large enough."

GENERAL.

IN a paper read before the Paris Academy on April 29th MM. Hericourt and Ch. Richet announce that they have applied the method of injecting serum in the treatment of cancer. Two patients only have undergone this treatment, one of whom is said to have been completely cured.

REV. J. M. SEELYE, president of Amherst College from 1877 to 1890, died at Amherst on May 12th, at the age of seventy. For nineteen years before his election to the presidency he filled the chair of mental and moral philosophy and retained this chair until his death. His original contributions to philosophy were not important, but he exercised great influence as an educator and teacher.

WE learn that Deputy Surgeon-General John S. Billings, of the army, has requested that he be placed on the retired list; and that in October that distinguished officer will leave the Army Medical Museum, of which he is curator, and the Library of the Surgeon-General's Office, of which he is librarian, and these magnificent institutions, that have been made what they are largely by his ability and zeal, will know him no longer. Before the date he has selected for his retirement he hopes to complete his work on the final volume of the Index Catalogue. In seeking official retirement Dr. Billings does not propose to give up work, as he has accepted the chair of

hygiene in the University of Pennsylvania. —*N. Y. Medical Record.*

Dr. Carl Thiersch, professor of surgery in the University of Leipsic, died on April 20th at the age of seventy-three. He was appointed professor of surgery at Erlangen in 1854, and in 1867 proceeded to Leipsic. During the Franco-Prussian war he was attached as senior surgeon to the 12th Army Corps. He was the author of standard works on cholera and embryology.

The number of medical journals at present published in Russia is 38. Of these 20 are published in St. Petersburg, 5 at Moscow, 4 at Warsaw, 2 at Odessa, 2 at Charkoff, and 1 at Kasan, Kieff, Saratoff, Woronesz and Pultawa, respectively. The oldest of them all is the *Medizinskoie Obozrenie*, which is twenty-one years old; next comes the *Russkaia Medizina*, which is in its nineteenth year; the *Vratch*, which is in its fifteenth, being third.—*N. Y. Medical Record.*

We much regret to learn that the publication of *Insect Life* will cease with the next number. Two new series of bulletins will be started from the Division of Entomology of the Department of Agriculture to take its place. The one will contain articies of a general economic and biological character —practically such articles as have been published most frequently in *Insect Life*— and the other will contain results of the purely scientific work of the office force.

There has been established in Leicester, England, a bacteriological institution under the direction of a medical officer in the interests of anti-vaccination.

Edward Burnett Tylor, M. A., Reader in Anthropology in the University of Oxford, has been made Professor of Anthropology.

Prof. W. M. L. Coplin, who holds the Chair of Pathology at Jefferson Medical College in Philadelphia, has accepted the call tendered him by the Trustees of Vanderbilt University, Nashville, Tenn., to take charge next fall of the departments of Pathology, Biology and Bacteriology, for which they have just completed a new building.—*N. Y. Evening Post.*

Brigadier General Thomas L. Casey, having reached the age requiring retirement from the active list, has relinquished command of the corps of engineers and charge of the engineer department. He is succeeded by Col. William P. Craighill.

We learn through the *N. Y. Medical Record* that the Medical Department of the State University of Minnesota was granted $40,000 by the Legislature for a laboratory building, making a total of $150,000 appropriated for buildings alone in a period of four years. The medical law was likewise amended to require of all graduates of later date than 1898 'attendance upon four courses of medical lectures, in different years, of not less than six months' duration each.'

The trustees of Williams College have accepted the legacy of $20,000 from Mme. Souberville, in memory of her father, Horace F. Clark, D. D. The College has also received a gift of $3,500 from ex-Governor Pennoyer, of Oregon, to found a scholarship in memory of his son.

Dr. Ernst Ritter, of the University of Göttingen, has been elected Assistant Professor of Mathematics in Cornell University.

The death of Mrs. Henry C. Lewis, of Coldwater, Mich., leaves the art collection possessed by her late husband, valued at $300,000, at the disposal of the University of Michigan. At present the university has not accommodation for the bequest, but President Angell expects an art building to be erected by private contributions. *N. Y. Evening Post.*

An exhibition of California food products will be held in Berlin from the 5th of May to the 5th of July.

THE *Scientific American* for May 11th contains an interesting illustrated account of Purdue University, Lafayette, Indiana.

THEODOR JOHANN CHRISTIAN AMBDERS BRORSEN, the astronomer, died on April 3d at Norburg in Schleswig at the age of 76. He was director of the observatory of Seuftenberg for twenty years.

THE death is announced, at the age of 64, of James Price, President of the Society of Civil Engineers of Ireland, Professor in the University of Dublin and Engineer in Chief of the Midland and Great Western Railway Company.

THE third International Congress of Zoölogy at Leyden is divided into six sections, as follows: (1) General Zoölogy, Geographical distribution, including fossil faunas. (2) Classification of Vertebrates, Geographical distribution. (3) Comparative Anatomy of Vertebrates, living and fossil. Embryology. (4) Classification of Invertebrates, Geographical distribution. (5) Entomology, (6) Comparative Anatomy and Embryology of the Invertebrates.

THE Craven Studentship at Cambridge has been awarded to Mr. R. C. Bosanquet. This is an endowment for advanced studies abroad in the languages, literature, history, archæology, or art of ancient Greece or Rome, or the comparative philology of the Indo-European languages.

IN a demurrer filed by Mrs. Jane L. Stanford in the United States Circuit Court at San Francisco it is contended that, since no valid claim was ever presented to Leland Stanford during his life or to his widow since his death, any claim the United States Government might have had on the Stanford estate is vitiated.

HON. ECKLEY B. COXE, a prominent mining engineer and writer, at one time President of the American Institute of Mining Engineers, died at Hazleton, Pa., at the age of fifty-four years.

BRIGADIER GENERAL CHARLES SUTHERLAND, formerly Surgeon-General of the Army, died at Washington, on May 11th, at the age of sixty-five years.

THE first *conversazione* of the Royal Society for the season was held on the evening of May 1st in Burlington-house, and there was a very large attendance of guests. The exhibits were exceptionally numerous, electric science and applied mathematics being well represented, while some interesting exhibits were also shown in the department of chemistry, astronomy and biology.—*London Times*.

PRINCIPAL PETERSON, of Dundee College, has been offered the presidency of McGill University, Montreal.

DR. J. H. HYSLOP has been made professor of logic and ethics in Columbia College, and Dr. Frederick S. Lee, adjunct professor of physiology.

LÉOPOLD TROUVELOT died on April 22d at the Observatory of Meudon at the age of 68. After the *coup d'état* he left France and came to America, living in Cambridge until 1882. His first published work appeared in Boston in 1866. At this time he was a student of natural history, but later he obtained a position as astronomer at Harvard College. His most important work was on the planet Venus, published in 1892. He was well known for his drawings, many of which still remain unpublished. He leaves an unfinished memoir on the planet Mars, and at the time of his death was engaged on a study of Jupiter.

DR. JOHN W. BYRON, who died on May 8th at the age of 34, was known for his researches in bacteriology carried out at Havana during the yellow-fever epidemic, later in the laboratories of Berlin and Paris, and during the last five years in the Loomis Laboratory, where he occupied the position of bacteriologist. Dr. Byron is said to have contracted the disease of which he died in

carrying out his experiments on tubercle bacilli.

The American Forestry Association proposed holding its annual peripatetic meeting in southern New Jersey from May 16th to May 19th. The privileges of this expedition are open to all members of the American Forestry Association, New Jersey Forestry Association and Pennsylvania Forestry Association. On May 15th Prof. B. E. Fernow was to deliver an illustrated lecture at Camden, from which place the party would start, going down the Delaware by steamboat, visiting all places of interest along the shore from Cape May to Atlantic City and in the pines. On the evening of May 17th an illustrated lecture was to be delivered in Atlantic City by Prof. Joseph Rothrock, Forestry Commissioner for Pennsylvania.

At a meeting of the Fellows of the Royal Botanical Society held in the Societies' gardens at Regent's Park, London, the question of the desirability of opening the gardens to the public on Bank holidays was discussed. It was stated at the same meeting that unless some fresh source of income could be obtained the gardens could not be kept up.

At the spring meeting of the Iron and Steel Institute the Bessemer gold medal of 1895 was unanimously awarded to Henry Marion Howe, of Boston, in recognition of his contributions to metallurgical literature. Among the previous recipients of the medal were Peter Cooper, Abram S. Hewitt, Alexander L. Holley and John Fritz. Mr. Howe's most important work is a treatise on the 'Metallurgy of Steel,' which was published in 1890 and for which he received a prize of $500 from the Société d' Encouragement of Paris.

The 66th anniversary meeting of the Zoölogical Society of London was held on April 29th. The chair was taken by Sir William H. Flower. The report of the Council stated that the silver medal had been awarded to Mr. Henry H. Johnston, Commissioner for British Central Africa, for his distinguished services to all branches of natural history. The total receipts of the Society for 1894 amounted to £25,107, a decrease of £1,110 being attributed to the unfavorable weather of the past year. The expenditure amounted to £23,616, a decrease of £1,661. The number of animals in the Zoölogical Gardens on December 31st last was 2,563, of which 669 were mammals, 1,427 birds and 467 reptiles. About 30 species of mammals, 12 of birds and one of reptiles had bred in the gardens during last summer. Sir William H. Flower was re-elected president.—*London Times.*

SOCIETIES AND ACADEMIES.

SCIENTIFIC SOCIETIES OF WASHINGTON.

A joint meeting of the Scientific Societies of Washington was held May 10th, on the occasion of the delivery of the annual address of the President of the National Geographic Society, Hon. Gardiner G. Hubbard. Dr. G. Brown Goode presided, and in the introductory remarks briefly outlined the development of the Societies and their joint commission.

Mr. Hubbard's subject was 'Russia.' He considered it in the light of his own observations while making an extensive journey through that country in 1881. Its climate, physiographic features, government and the customs and conditions of its people were all graphically portrayed. At the close of the address a series of views were shown upon the screen.

In response to a motion by Prof. Simon Newcomb, seconded by Postmaster General Wilson, the large audience gave Mr. Hubbard a hearty vote of thanks for his address.

J. S. Diller, *Secretary.*

BIOLOGICAL SOCIETY OF WASHINGTON.

At the meeting on May 4th, Mr. Charles Torrey Simpson read a paper 'On the Geo-

graphical Distribution of the Naiades,' an abstract of a paper on classification and distribution soon to be published.

After stating that the classification adopted by most authors, in which the family *Unionidæ* is founded on forms without siphons, and the *Mutelidæ* on those in which they are developed, cannot stand, since these characters vary in the same genus or species, the writer showed that von Ihering's new definition of the families, in which the former was based on the embryonic state being a *glochidium* and the latter by its larvæ being a *lasidium* agreed with the shells. In the *Unionidæ* these are *schizodont*, in the *Mutelidæ* they are irregularly *taxodont*. The new arrangement shows the former family to be world-wide; the latter as belonging essentially to the southern hemisphere.

The Naiads are distributed in Geographical Provinces whose boundaries may be mountain chains which act as watersheds between river systems, deserts or oceans, but these do not always divide regions, which sometimes have no tangible barriers. In the Old World and South America these provinces essentially agree with those established by Sclater and Wallace; in North America they do not.

The Palæarctic Region includes all Asia south to the Thibetan Plateau, and all the western part of the continent, all Europe and northern Africa, and all of North America west of the Great Cordillera; an area of 16,000,000 square miles, with only a few, not over 50, simple forms. The Oriental Region includes all of Asia south of the Himalayas, north to the Amoor, west to the Indus, Japan and the Malay Archipelago to the Salomon Islands. The forms are numerous, often heavy, distorted, elegantly sculptured, and closely related to those of the United States.

The Australian Region includes Australia, Tasmania and New Zealand, with a few simple unios related to those of South America. Africa south of the Desert is another great region, the Ethiopian, containing the African *Mutelidæ* and small unios allied to those of India. South America is all included in another province, the Neotropical, the Andes proving a barrier to the passage of all forms except unios, which have crossed to the western slope. All the central United States drainage from West Florida to the Rio Grande, including, for the most part, the Great Lakes and the Mackenzie System, constitutes a wonderfully rich region of naiad life, having the finest and most varied forms of the globe. The waters of North America draining into the Atlantic are peopled by simple forms, which may have descended from those of the Mississippi Valley. Mexico and Central America constitute another region of naiad life, having three distinct faunas, an ancient one derived from the United States, a more recent one from that region, and a few immigrants from South America.

Mr. Simpson attempts to trace the development and past history of the naiads, and their evidence regarding past changes of land and sea and the Glacial Epoch.

The paper was illustrated by a sketch-map in colors, showing the different regions.

The second paper of the evening, 'The Other Side of the Nomenclature Question,' was by Dr. Erwin F. Smith, who spoke, in reply to a previous paper by Mr. F. V. Coville, against the unfounded claims put forth in behalf of the Botanical Club Check List. This list has introduced many radical changes into our existing botanical nomenclature without sufficient reason. The revival of the long disused generic names of Rafinesque *et al.*, and the retro-active application of the rule "Once a synonym always a synonym," whereby many generic names of long standing have been discarded, are specially objectionable, and will not bear the light of criticism. Only a few people

are urging the adoption of these ultra rules. The best systematic botanists of the world are opposed to them, and there is such a widespread and determined opposition to them in the botanical fraternity generally, both in this country and in Europe, that the movement is certain to amount only to a lamentable schism. It has been claimed that nine-tenths of our American botanists are in favor of these rules, but such statements are wide of the mark. Some of these rules are in conflict with the Paris Code, and others claim to be a strict interpretation of it; but de Candolle himself, the author of this code, considered such interpretations of it as 'abuses,' and urged that the Paris Code of 1867 be so amended as to prevent the swamping of our nomenclature by ultra theorists.

One fact lost sight of by the movers of this new American system, for it has no following in Europe, is that science is an international affair, that the bulk of the botanical work of the world is done outside of the United States, and that even if we were all agreed on this side of the water, which is far from true, it would still be necessary to gain consent of botanists elsewhere before giving to these rules any more weight than mere suggestions. It will be time enough for American botanists to put them into practice when they have received the sanction of an International Botanical Congress. Another very strong objection to making radical changes in our botanical nomenclature is the extent to which botanical names are used in agriculture, forestry, horticulture, floriculture, pharmacy and medicine. There is nothing comparable to it in zoölogy. Only intolerable confusion can result from calling a plant by one name in botany and by another in horticulture or pharmacy, and it is surprising that the force of this argument was not perceived long ago. Finally, the Botanical Club rules do not have the sanction of the A. A. A. S., as might be inferred from some statements which have been made, and the organization of the Club is so loose as to be a fatal objection to regarding its doings or recommendations as in any sense binding on American botanists, when these are opposed by counter-recommendations proceeding from the most famous botanists in the world.

F. A. Lucas, *Secretary.*

BOSTON SOCIETY OF NATURAL HISTORY, MAY 15.

Notes on the Dissection of a Chimpanzee, with Especial Reference to the Brain: Prof. Thomas Dwight.

The Conditions of Escape of Gases from the Interior of the Earth: Prof. N. S. Shaler.

Samuel Henshaw,
Secretary.

THE MINNESOTA ACADEMY OF NATURAL SCIENCES, MINNEAPOLIS, MAY 7.

I. An Observation on Ants: O. W. Oestlund.

II. Remarks on Some Birds New to Minnesota: Dr. Thos. S. Roberts.

III. An Amine Compound of Gold: H. B. Hovland.

IV. The Chemical Characters of the Minnesota Sandstones: Chas. P. Berkey.

V. Miscellaneous Business.

C. W. Hall, *Secretary.*

NEW BOOKS.

Zur Psychologie des Schreibens. W. Preyer. Hamburg and Leipzig, Leopold Voss. 1895. Pp. 230. M. 8.

The Female Offender. Cæsar Lombroso and William Ferrero. New York, D. Appleton & Co. 1895. Pp. xx + 313. $1.50.

Story of the Innumerable Company. David Starr Jordan. Stanford Univ. Press. 1895. Pp. 38.

Short Studies in Nature Knowledge. William Gee. London and New York, Macmillan & Co. 1895. Pp. xiv + 313. $1.10